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Results of Seismic Piezocone, Flat Dilatometer, and True-Interval Downhole Shear Wave Testing

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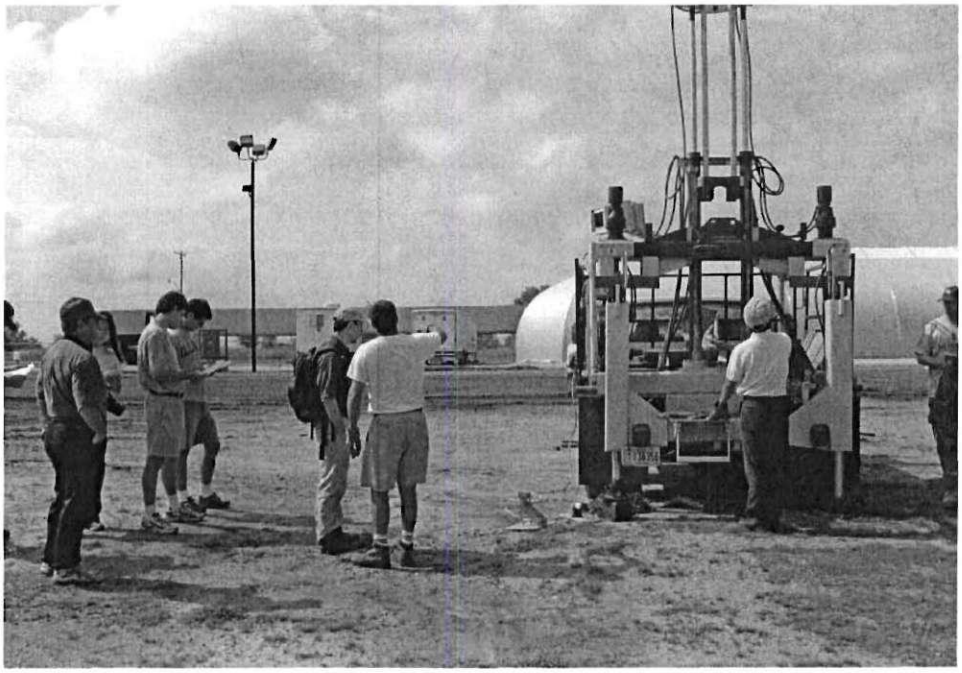
Abstract: The GT In-Situ Research Group conducted field testing to improve the procedures for conduct & interpretation of seismic piezocone testing for geotechnical site characterization. By including periodic dissipations in the soundings, a five separate measurements on soil behavior can be developed from the test, designated as SCPTù, including: cone tip resistance (q_t), sleeve friction (f_s), penetration porewater pressure (either u_1 at midface or u_2 at the shoulder), time rate of dissipation (t_{50}), and downhole shear wave velocity (V_s). These data can be used to stratify the soil layers, evaluate the small-strain stiffness, and determine soil parameters such as shear strength, friction angle, overconsolidation ratio, permeability, and soil modulus. In addition, flat dilatometer testing (DMT) was conducted to provide additional measurements at the site.

At our initial site for the Ford Design Center, these data complement the ongoing laboratory testing program at Northwestern University by Professor Rich Finno. The excavation system has been instrumented to allow feedback to the numerical modeling and updating sequences by Professor Youssef Hashash at Univ. of Illinois at Urbana-Champaign. Data were also collected at the NGES site established by Professor Finno for the 1989 Geotechnical Engineering Conference (GSP 22). To explore the use of the true-interval direct push probe for downhole shear wave velocity profiling, additional series of tests have been made at three sites: (1) NGES near Opelika, AL that is underlain by Piedmont residual fine sandy silty soils; (2) soft alluvial sediments at Mud Island, Memphis, TN, and (3) the calcareous Cooper marl in Charleston, SC.

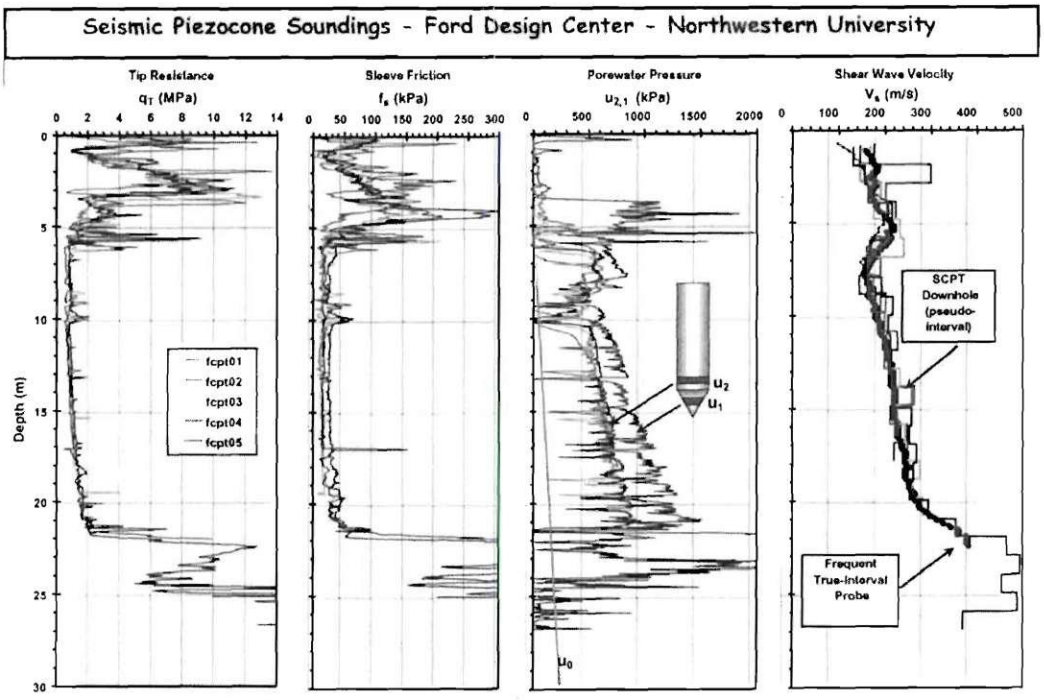
The following graphs show the summary plots from the SCPTU and DMT soundings conducted at the Northwestern University campus and neighboring NGES. Here, the upper layers consist of sand and sandy fills overlying soft lacustrine silty clays, as described by Finno (1989, GSP 23).

Demonstrations of the field tests were given to graduate students from NU and later during a visit to UIUC. Photos of the GT Geostar cone truck that is used to hydraulically advance these tests are shown. This rig utilizes twin earth anchors at the back end to provide reaction for testing and has allowed the small 6-tonne truck to achieve depths of up to 35 to 40 m at test sites in AR, MO, TN, SC, AL, and NC.

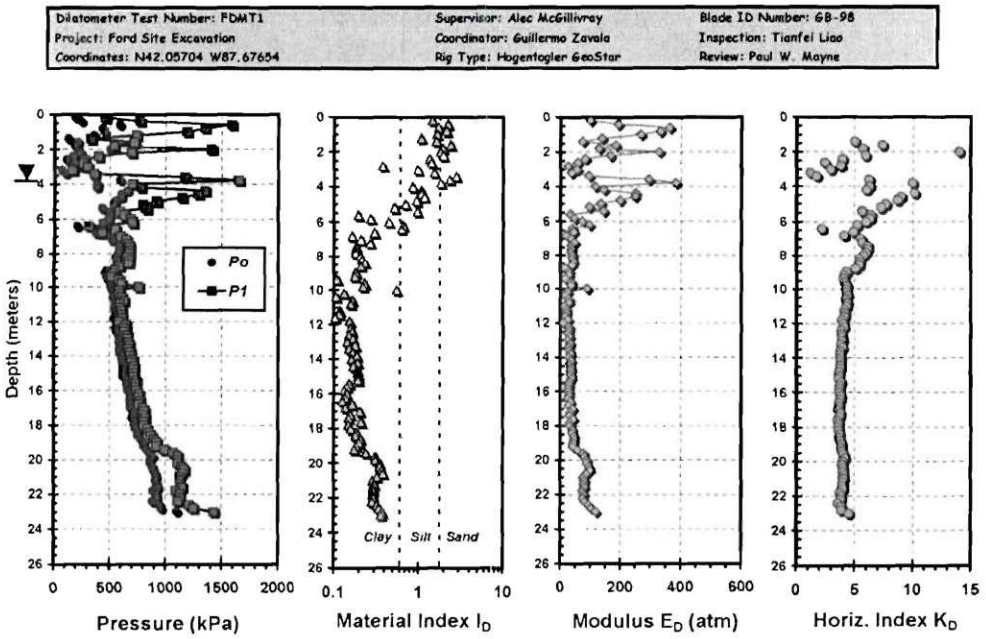
Field testing at Ford Design Center site on Northwestern University campus



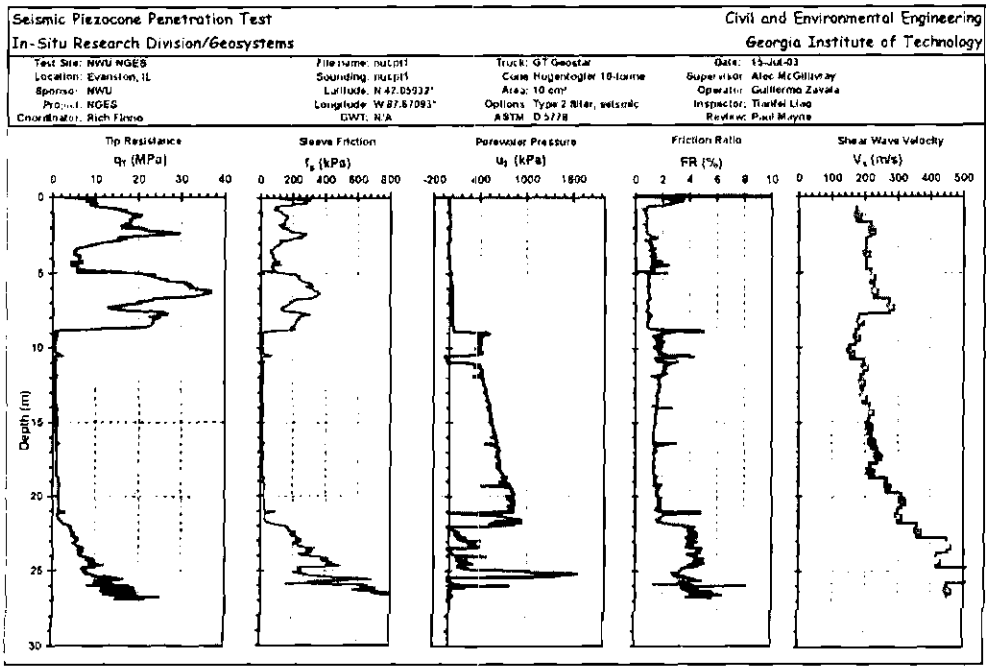
Demonstration of cone rig at University of Illinois (UIUC)



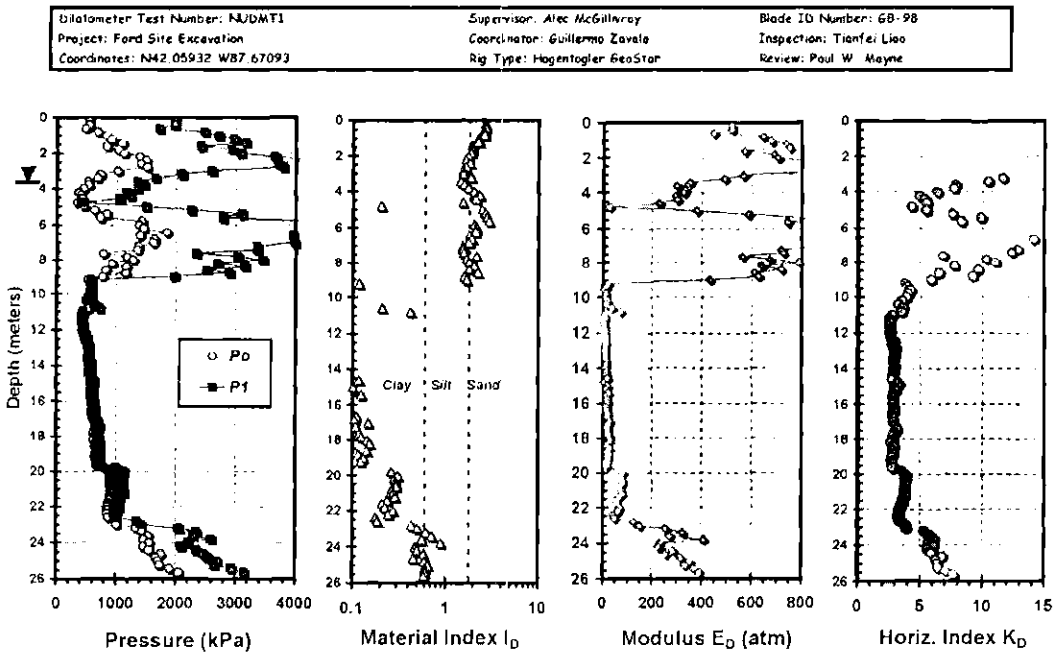
Summary results of seismic piezocone testing at Ford Design Center site, NU



Results of flat dilatometer testing at Ford Design Center site, NU



Results of representative seismic piezocone testing at NGES, Northwestern University, IL



Results of flat dilatometer testing at NGES, Northwestern University, IL